Essentially popular and "gossipy" in its style, Miss Fulcher's "Among the Birds" is written by an enthusiastic bird-lover for other bird-lovers—whether young or old—who desire information on a fascinating subject without entering into zoological technicalities. As we learn from the preface, a number of the chapters have already appeared in various journals and magazines; and, in spite of the multitude of bird-books relating to the British Islands, they seem decidedly worthy of reproduction in permanent form. For the author has much of the fascination of style characteristic of "A Son of the Marshes," and writes mainly, if not entirely, from personal experiences of her feathered friends, her observations extending from the peaceful meadows and fields of Middlesex and Hertfordshire to the rugged moors and sea-cliffs of Scotland and the Farne Islands. Indeed, if the author has a fault, it is in a somewhat overweening confidence in her own opinions and theories, this being especially noticeable in the chapter on migration. And in this connection it may be mentioned that there are other English ornithologists besides Mr. C. Dixon who have written on the last-mentioned subject.

Personally we are of opinion that the author is at her best when describing birds in their actual haunts, the chapters on migration, nests, song and the "ministry of birds" being far less satisfactory than those dealing with the avifauna of particular stations. The chapters which strike us as being the most interesting are those entitled "The Tern Nursery on the Noxes," "Birds on the Wide Opens," "Guillemots on the Pinnacles," "Puffins" and "Birds of a Sea Marsh." In the second of these we have been particularly attracted by the description of the oyster-catcher. "Its form," writes the author, "is attractively odd and quaint as it rests heavily on its long and delicate pink legs. But the feature which distinguishes it from all British birds is the beak—the great staff of coral on which the bird seems to rest, when it stands with head bent, as a kangaroo rests on its tail—the great load of coral which seems to weight the bird's head so that it bows at every step it walks, and which it holds out like a herald's trumpet as it flies: two great mandibles of coral, thick and long, twice as long as the bird's head, and almost twice as thick as its long and slender legs. Why it requires such an implement is not quite clear." This, which is by no means a solitary instance, is distinctly original, and originality is a consummation much to be desired in natural history writings.

With the ways of the poacher the author displays considerable familiarity; and her statement of the manner in which illicitly killed grouse are preserved in Ireland till the 12th of August will probably be a revelation to many of our readers. She is perhaps unnecessarily severe on those who enjoy a dish of roast larks or a plover's egg; and, we believe, she decidedly over-estimates the fear of any serious diminution in the number of either lapwings or larks in this country. But all will be with the author in her endeavour to promote increased protection for birds in such cases as it may be demonstrated to be necessary.

In spite of the competition to which allusion has already been made, it may be hoped that lovers of birds will find a place in their bookcase for the present attractive little volume. R. L.

CHRONICA MATHEMATICA.

A Brief History of Mathematics. An authorised translation of Dr. Karl Fink's "Geschichte der Elementar-Mathematik." By W. W. Beman and D. E. Smith Pp. xii + 334. (London: Kegan Paul, Trench Trübner and Co., Ltd., 1900.)

THANKS, in great measure, to the unwearied industry and acumen of Dr. Moritz Cantor, it is now comparatively easy to construct a synopsis of mathematical history down to the beginning of the nineteenth century. It is true that success depends upon much more than a mere knack of précis-writing: the task requires judgment, discrimination and a certain kind of sympathy; still, the labour of such a work is greatly simplified now that the essential facts have been made accessible in Dr. Cantor's incomparable lectures. But when the historian loses the aid of this accomplished guide, and endeavours to carry on the tale down to our own time, he is at once met by serious difficulties, even if he confines himself to a strictly limited field. Most of the writers of popular histories of mathematics break down hopelessly when they reach the nineteenth century; they are hampered by the limitations of their own knowledge, and a consciousness of the difficulty of writing so as to be understood by the audience to whom they address themselves.

Prof. Fink, with rare and admirable courage, has disdained to shirk the problem, and has made a conscientious effort to trace the development of his subject down to the present day. The range of his work is limited to "elementary mathematics," that is to say, arithmetic, elementary geometry and algebra, and trigonometry; this has, of course, lightened his task considerably. But he has kept in view the connection of these subjects with those far-reaching theories which have grown out of them during the century now drawing to its close; and this has led him to give an outline of the course of modern research in such things as the theory of equations, function-theory, projective geometry, and non-Euclidian geometry. Moreover, he has not neglected to draw attention to the various tendencies of contemporary schools, and the directions of current investigation.

To do all this in such brief compass has involved severe limitations. Prof. Fink writes for the mathematical student, not for the dilettante, and assumes that his reader is acquainted with the ordinary technical terms of the science. Legendary biographies and items of irrelevant gossip are rigorously excluded; the author has faith enough in the intrinsic interest of his subject to refrain from larding it with scraps of tittle-tattle. The style, too, is concise almost to a fault; the translation, at any rate (and, we should imagine, the original work as well), is not distinguished either by grace or lucidity. But the substantial merits of the book, its well-considered plan its general trustworthiness, and its stimulating character, deserve cordial recognition.

In a work of this kind mistakes in detail are practically unavoidable. No one man possesses such a thorough knowledge of mathematics as to protect him from occasional error when he tries to make a survey of the whole field, or of any considerable part of it. For the correction of such inevitable errors the author must depend

upon the help of those who have paid special attention to particular lines of research; and it is with the intention of doing a service of this kind that the remarks which now follow have been made.

On p. 137 "the form $x \equiv a$ (mod. b), identical with $\frac{x}{b}=y+a$" should be corrected, at the end, by printing $x=by+a$. On p. 142 Reuschle's tables of 1856 are mentioned, but not his "Tafeln complexer Primzahlen" (Berlin, 1875). By an extraordinary oversight, it is said, on p. 207, that "we can construct a regular polygon of n sides only when $n-1=2^{2^p}$ (p an arbitrary integer)," although a correct statement (so far as it goes [1]) is given, pp. 161–2. On page 162, again, it is apparently said that Baltzer was the first to notice that 2^n+1 is not always prime when n is a power of 2; as a matter of fact, Euler proved that $2^{32}+1$ is divisible by 641 (*cf.* Smith's "Report on the Theory of Numbers," Art. 61).

On page 259, after explaining von Staudt's interpretation of "imaginary points" as double elements of involution-relations (which is not strictly correct: the involution itself, *plus* a distinguishing "sense," is the imaginary point), the author says, "This suggestion of von Staudt's, however, did not become generally fruitful, and it was reserved for later works to make it more widely known by the extension of the originally narrow conception." Besides being rather disparaging in tone, this is likely to convey a wrong impression. It is true that Kötter and others, in trying to extend von Staudt's theory to curves of higher orders, have been led to introduce involutions of a more general kind than his; but this does not affect his definition of an imaginary point, which is perfectly general and complete. The imaginary points in which a curve of any order is met by any line must admit (theoretically) of representation by involutions in von Staudt's sense: just as an equation with ordinary complex coefficients has a set of ordinary complex roots. The equation may be, from some points of view, insoluble or irreducible, and we may find it convenient to keep all its roots together; it is this which corresponds to the case of these "higher" involutions.

There are some obscurities which may be due to the author or translators or both. Thus, p. 250, "Möbius started with the assumption that every point in the plane of a triangle ABC may be regarded as the centre of gravity of the triangle:" (this is partially cleared up by the context). On p. 205, line 4, the sentence beginning "The semiparameter" is unintelligible, and is probably a mistranslation. Page 147, "the theory of binary forms has been transferred by Clebsch to that of ternary forms (in particular for equations in line co-ordinates)" is a very inadequate account of Clebsch's "Uebertragungsprincip," and will hardly convey any definite idea to the average reader.

Two obvious slips in translation may perhaps be mentioned. On p. 270, through not noticing an idiomatic inversion, the subject of a sentence has been treated as the predicate, and *vice versâ*: read "this point is offered by the eleventh axiom." On p. 203, for "and also with the normals" read "that is to say, with the normals:" *also* has been confused with *auch*, or rather with our "also." Finally, by the omission of an "s," Plücker has been made to say that "he (Monge) introduced the equation of the straight line into analytical geometry."

At the end of the book there are short biographical notices of a number of mathematicians: the list has been recast by the translators. Whether it is worth the space it occupies (26 pp.) is rather doubtful. Many entries are either trivial, or anticipated in the previous part of the book. Some of the notes are misleading, to say the least. Cauchy is said to have "contributed" to the theory of residues, the fact being that he invented it. All that is said of Eisenstein is that "he was one of the earliest workers in the field of invariants and covariants"; this is true in a sense, but his fame rests principally on his arithmetical memoirs, and his researches on doubly infinite products and elliptic functions. Sophie Germain "wrote on elastic surfaces." Legendre "discovered the law of quadratic reciprocity," an erroneous statement which may be corrected by p. 138 of the book itself. And what is the use of such entries as "Donatello, 1386—1468. Italian sculptor"? It would be an improvement to cut down this list to the really important names, and to give indications of such trustworthy biographies, or other sources of information, as may be available. G. B. M.

[1] The necessary and sufficient condition that a regular polygon of n sides may admit of Euclidean construction with rule and compass is that the "totient" of n is a power of 2; in other words, $n=2^m pqr\ldots$, where m is zero or any natural number, and $p, q, r \ldots$ are *different* odd primes, *each* of the form 2^k+1. The values of n below 100 are excluding 2) 3, 4, 5, 6, 8, 10, 12, 15, 16, 17, 20, 24, 30, 32, 34, 40, 48, 51, 60, 64, 68, 80, 85, 96.

THE SCIENCE OF COLONISATION.

New Lands: their Resources and Prospective Advantages. By H. R. Mill, D.Sc., LL.D. Pp. xi + 280. (London: Charles Griffin and Co., Ltd., 1900.)

THE present is a very appropriate time for the publication of this book. Public attention is occupied with Imperialism and colonial development, so that a trustworthy statement of the resources and conditions of life in the countries of the temperate zone, where there is still an opening for the energies of English-speaking people, should be of real service. The colonies and countries described from this point of view are Canada, Newfoundland, United States, Mexico, Temperate Brazil, and Chile, Argentina, the Falkland Islands, Australia and Tasmania, New Zealand and South Africa. To intending settlers and capitalists desiring to know the prospects of success in these countries the book will be invaluable; for it brings together in a convenient and concise form all the essential particulars available in official reports and other authoritative works.

This is what the practical man wants, and he will probably not concern himself seriously with the chapter in which the development of new lands is considered in its scientific aspects, yet to our minds this chapter is the most valuable in the book, and every statesman and colonial official anxious that the progress of his country shall be steady and permanent should be familiar with the principles it contains. It is an instructive statement of the factors which ought to be considered in connection with the development of every land, but are often neglected.

Take, for instance, the subject of geographical boundaries. It is the British habit not to give any serious attention to this subject until forced to do so by a dispute with a neighbouring nation. As Dr. Mill remarks: